REPORT OF THE
VIRGINIA DEPARTMENT OF TRANSPORTATION
IN RESPONSE TO ITEM 570 OF THE 1992 BUDGET (HB30)

A Study of Enhanced Public Bus Service Along the I-495 Corridor in Virginia

TO THE GOVERNOR AND
THE GENERAL ASSEMBLY OF VIRGINIA

HOUSE DOCUMENT NO. 61

COMMONWEALTH OF VIRGINIA
RICHMOND
1993

TABLE OF CONTENTS

BELTWAY TRANSIT STUDY
EXECUTIVE SUMMARY

I. INTRODUCTION

The purpose of this Study, per Legislative mandate as expressed in House Bill 30, Item 570, was to analyze "enhanced public bus service along the I-495 corridor in Virginia." Specifically, it was noted that, "The study shall include an analysis of the following items: (1) service linking Virginia and Prince George's County, Maryland via the Woodrow Wilson Bridge; (2) a network of timed transfer service to include Metrorail Stations, Virginia Railway Express Stations and major residential and employment centers as outlined in the *Northern Virginia Subregional Plan;* and (3) a plan for phased implementation of this service, including a one-year pilot project."

II. STUDY SCOPE AND PROCESS

As indicated in the Legislative language, this Study was conducted with the active involvement of the affected jurisdictions and transit agencies in Northern Virginia. Staff from the Department of Transportation's Northern Virginia District Office was asked to coordinate the Study efforts and, with the assistance of the staffs of participating jurisdictions and agencies, perform the technical analysis required.

To this end, a Study Team was organized to give direction to the project. The following jurisdictions and agencies were represented on the Study Team:

- Prince George's County, Maryland
- Maryland Department of Transportation
- Maryland State Highway Administration
- Maryland-National Capital Park and Planning Commission
- Washington Metropolitan Area Transit Authority
- Metropolitan Washington Council of Governments
- City of Alexandria
- Fairfax County, Virginia
- Northern Virginia Transportation Commission
- Virginia Department of Rail and Public Transportation
- Virginia Department of Transportation.

The Study Team was convened in July of 1992, with its first task being to further define the Study Scope and to develop appropriate phasing for the Study Project. Given the short time frame within which this Study was to be conducted, the Study Team agreed, at the outset, that the work should be done in phases; and that the first phase should focus on examining the potential for a specific bus route or routes which would provide service linking Virginia and Prince George's County, Maryland via the

Woodrow Wilson Bridge. The potential for linking rail stations, VRE, and major employment and residential centers would, therefore, also be focused for the first phase within that service area.

It was the consensus of the Study Team that a broader analysis, examining the potential for phased implementation of transit around the entire Beltway and including an analysis of how a more extensive network of timed transfer centers might actually function, should be pursued as a second phase. A major reason for recommending a delay in this broader analysis included the desire to await the outcome of a Study which was then underway at the Metropolitan Washington Council of Governments' Transportation Planning Board addressing the potential for circumferential transit in the Beltway Corridor.

III. STUDY CONDUCT

Having agreed to focus on the more narrow question of defining the potential for experimental bus service between Virginia and Maryland via the Woodrow Wilson Bridge, staff proceeded with the analysis outlined below. (Details of this technical analysis are included in the attached Technical Report.)

- Travel data from three different sources were made available. They were:
  - 1990 Metrorail Passenger Survey
  - 1992 License Plate Survey by COG of Woodrow Wilson Bridge users. From this data, origins and destinations of users by trip purpose were obtained.
  - 1995 COG Travel Simulation of home-based work trips for the entire region.
- Data from the latter two surveys were grouped into a matrix of 20 "Districts" showing the travel patterns of trips between home and work.

This data provided a wealth of information from which to estimate the usage of numerous bus routes across the Woodrow Wilson Bridge. Described below and on the following page are those routes which held the most promise for a one-year pilot project and were subsequently investigated at a greater level of detail:

WESTBOUND

Route A From the Oxon Hill Park-and-Ride Lot, located off of Maryland Route 210, to the King Street Metrorail Station in Alexandria.

Route B From the Oxon Hill Park-and-Ride Lot to the King Street Metrorail Station and then via Duke St., Van Dorn St., and Edsall Rd. to the Shirley Industrial Park.

EASTBOUND

Route C From the Huntington Metrorail Station to the government installations along the I-295 corridor and then on to the Anacostia Metrorail Station.

Route D From a free park-and-ride lot located in the vicinity of the Springfield Mall to the government installations along the I-295 corridor.

IV. STUDY RESULTS

The table below summarizes projected ridership, costs, revenues, and cost recovery ratios for the proposed routes. Westbound (WB) routes were combined with eastbound (EB) routes to eliminate empty busses crossing the Potomac River.

TABLE 1
SUMMARY OF ROUTE PROJECTIONS

Route (mile/hrs)	Daily One-Way Ridership WB	EB	Annual Revenue ($1,000)	Annual Costs ($1,000) WMATA	Loc/Prv	Rev/Cost % WMATA	L/P
Route A-C (140,250/8,250)	247	162	$102	$508	$370	20%	28%
Route A-D (211,000/11,000)	247	400	$162	$715	$521	23%	31%
Route B-D (229,250/13,000)	332	400	$183	$814	$610	22%	30%

An explanation of the data in Table 1 is as follows:

- Daily one-way ridership was obtained by taking the travel patterns of commuters from three data sources and estimating bus ridership on the westbound and eastbound bus routes using mode split estimates from COG's "Fact Book". Table 1 shows the estimated maximum number of bus riders to be 332 westbound and 400 eastbound for the morning rush period. Commuters are expected to ride the return bus in the evening. It should be noted that these ridership estimates were goals which were to be achieved after one year of operation.

- Annual revenue was based on $0.50 per trip times 250 operating days per year.

- Annual operating costs were derived using unit cost data obtained from WMATA and a local/private (L/P) operator (Fairfax County Connector). Costs accounted for mileage, operating hours, and depreciation.

  It should be noted that these costs did not include any costs to acquire busses or other equipment should it be necessary to do so at start-up.

- Revenue to cost ratio, commonly called the cost recovery ratio, is a measure used in the transit industry to gauge the success of a particular service. A ratio of 35% is deemed acceptable for transit bus service. As indicated in the table, it was projected that Route A-D (if it was operated by a local jurisdiction or private contractor), could have a cost recovery ratio of 31%, which is almost acceptable.

V. POTENTIAL FUNDING

An exploration was made into potential funding sources for such a pilot bus program. Federal, State, and local sources were reviewed for their general applicability. While several of the programs offered some promise, no immediately available funds were identified for this purpose. A more detailed investigation was not pursued in Phase I, given the consensus of the Study Team regarding the viability of a pilot project, as discussed below.

VI. RECOMMENDATIONS

After completing the analysis and discussing the findings, it was the view of the Beltway Transit Study Team that Bus Route A-D exhibited the most potential of the routes studied in detail. However, the Team felt that they could not recommend to the Legislature implementation of this route as a pilot, stand-alone project at this time.

This conclusion was based on the Team's consensus that a primary objective of the Legislature's request for a pilot project was to relieve congestion on the Wilson Bridge. With 172,000 vehicles per day crossing the Wilson Bridge - approximately 8% (13,200) in the peak hour - a reduction in auto demand of 200 vehicles $\pm$ would have minimal impact on relieving congestion on the Bridge.

As a second phase to this Study, the Team recommends focusing on an intermodal systems approach to addressing congestion relief on the Capital Beltway - and the Woodrow Wilson Bridge in particular. Transit, van pools, car pools, subscription bus service, HOV lanes, timed transfer centers, and provision of park-and-ride lots around the Beltway Corridor all need to be examined to identify the potential for a "package" or "packages"

of measures that could contribute substantially to congestion relief. Appropriate phasing and funding for implementation should be identified as part of this second phase process. To accomplish this, VDOT and the Department of Rail and Public Transportation will work with the Transportation Planning Board staff, local jurisdictions and Maryland through the regional process to develop a transportation program in the Beltway Corridor.

In the interim, the Study Team recommends an intensive marketing campaign to promote existing transit, carpool, and vanpool programs that have the potential for diverting single occupant vehicles from the Wilson Bridge. This effort should involve the area's ridesharing programs, working in concert to target larger employers and some residential neighborhoods in the Study area for transit and ridesharing promotions. Accompanying this effort there should be an overall examination of the adequacy of signage within the Beltway Corridor to direct commuters to existing transit facilities and services.

BELTWAY TRANSIT STUDY
TECHNICAL REPORT

I. INTRODUCTION

The purpose of this Study, per Legislative mandate as expressed in House Bill 30, Item 570, was to analyze "enhanced public bus service along the I-495 corridor in Virginia." Specifically, it was noted that, "The study shall include an analysis of the following items: (1) service linking Virginia and Prince George's County, Maryland via the Woodrow Wilson Bridge; (2) a network of timed transfer service to include Metrorail Stations, Virginia Railway Express Stations and major residential and employment centers as outlined in the *Northern Virginia Subregional Plan*; and (3) a plan for phased implementation of this service, including a one-year pilot project."

The purpose of this paper is to document the efforts made in fulfilling the Legislature's mandate and to outline further steps needed.

II. STUDY SCOPE AND PROCESS

As indicated in the Legislative language, this Study was conducted with the active involvement of the affected jurisdictions and transit agencies in Northern Virginia. Staff from the Department of Transportation's Northern Virginia District Office was asked to coordinate the Study efforts and, with the assistance of the staffs of participating jurisdictions and agencies, perform the technical analysis required.

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linking Virginia and Prince George's County, Maryland via the Woodrow Wilson Bridge. Linking of major employment and residential centers, as well as existing transit centers, would also be focused within this specific service area.

It was the consensus of the Study Team that a broader analysis, examining the potential for phased implementation of transit around the Beltway and including an analysis of how an entire network of timed transfer centers might actually function, should be pursued as a second phase.

III. TRAVEL DEMAND DATA SOURCES

In examining the potential for a specific bus route or routes which would provide service linking Virginia and Prince George's County, Maryland via the Woodrow Wilson Bridge, three data sources were used to estimate travel demand across the Woodrow Wilson Memorial Bridge:

- 1990 Metrorail Passenger Survey
- 1992 License Plate Survey Across the Wilson Bridge
- 1995 COG Travel Simulation.

Analysis of the data from each of these sources followed the steps listed below:

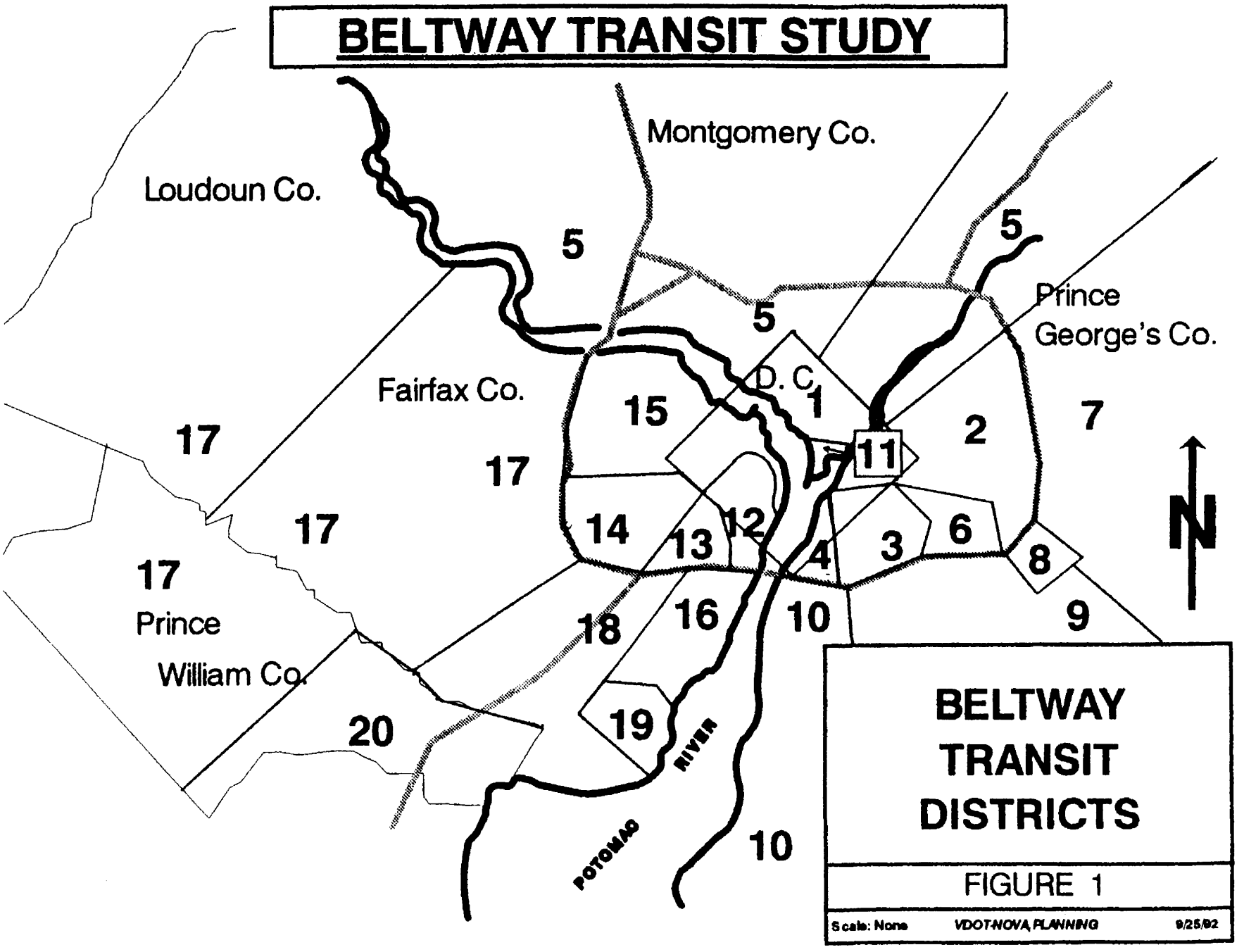
1. Metropolitan Washington was divided into 21 "Districts". Figure 1 depicts the districts developed for the Beltway Transit Study. Areas were aggregated into Districts based upon their location relative to the Wilson Bridge, primary means of access, identifiable boundaries, and other criteria. For example, the area primarily accessed by I-295 between the Capital Beltway and the Anacostia River and consisting of government employment centers was designated as District 4.

2. Data from each source were examined and those which were identified as home-based-work trips were separated from all other trips.

3. The home end of each trip was assigned to a district as was the work end.

4. Matrices were prepared which illustrated the magnitude of the trips from the home district to the work district.

5. The matrix from each source was analyzed in order to note districts which had a high number of trips between them, and it was compared to the matrices from the other sources to see if the demand in each was consistent.


BELTWAY TRANSIT STUDY
Montgomery Co.
Loudoun Co.
Prince George's Co.
Fairfax Co.
D. C.
Prince William Co.
POTOMAC RIVER
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BELTWAY TRANSIT DISTRICTS
FIGURE 1
Scale: None
VDOT-NOVA PLANNING
9/25/02

A. 1990 Metrorail Passenger Survey

The purpose of the 1990 Metrorail Passenger Survey was to collect data from Metro passengers regarding trip origin, trip purpose, trip destination, means of access and egress, and other relevant information. This was accomplished by giving 25% of boarding Metrorail passengers a questionnaire which was postage-paid. From those surveys returned, the data was expanded to account for all passengers who had passed through Metrorail's turnstiles.

B. 1992 License Plate Survey Across the Wilson Bridge

The purpose of the 1992 License Plate Survey Across the Wilson Bridge was to collect data from those crossing the Wilson Bridge as to their trip origin, trip purpose, trip destination, and other information.

On Tuesday, June 16, 1992 and Wednesday, June 17, 1992 a license plate survey was conducted of the vehicles crossing the Woodrow Wilson Memorial Bridge. Surveyed vehicles with plates from Maryland, Virginia, or the District of Columbia were matched by the respective states' Department of Motor Vehicles with the names and addresses of their owners. Vehicle owners were then mailed a survey which requested them, among other things, to identify trip origin, trip destination, and trip purpose.

C. 1995 COG Travel Simulation

The 1995 COG Travel Simulation was a third source of data for this Study. This data was the output of the WMCOG Mode Choice Model, which was run using a 1995 highway network and an 89-mile Metrorail system with supporting bus routes. Model outputs consist of transit trips, auto driver trips, auto person trips, HOV driver trips, and HOV person trips stratified by trip purpose and by trip origin and trip destination.

D. Summary of Survey Data

With respect to the Beltway Transit Study, analysis of the 1990 Metrorail Passenger Survey indicated that there are approximately 170 people, residing in the MD 210 traffic shed outside of the Capital Beltway (District 10), who drive or are driven across the Wilson Bridge to use either the Huntington, Eisenhower, King Street, Braddock Road, or Crystal City Metrorail Stations. From these Metrorail Stations, these residents of District 10 travel via Metro to other parts of the Metrorail system. This Survey did not identify anyone residing in Virginia who drives across the Wilson Bridge to access the Metrorail stations in Maryland.

Analysis of the 1992 License Plate Survey data (See Table 1) indicated that the area (district) in Maryland attracting the largest number of home-to-work vehicle trips was the I-295 corridor (District 4). The volume of trips attracted was at

TABLE 1

BELTWAY TRANSIT STUDY

HOME TO WORK VEHICLE TRIPS ON THE WILSON BRIDGE

MD/DC DISTRICTS — WORK — TUES., 6/16/92

VA DIST.	1	2	3	4	5	6	7	8	9	10	11	TOTALS
12	2	2	3	12	2	6	4	2	1	13	3	50
13	2	1	0	16	9	4	3	3	2	4	3	47
H 14	0	2	2	21	2	7	3	2	2	3	1	45
O 15	0	3	1	7	0	1	2	0	0	8	0	22
M 16	31	13	6	78	13	23	8	10	4	13	17	216
E 17	3	9	1	55	9	21	5	5	5	15	7	135
18	8	12	2	57	10	15	2	6	3	6	9	130
19	0	0	1	2	0	0	0	1	1	1	1	7
20	2	7	3	35	7	7	6	3	1	6	4	81
21	0	0	0	0	0	0	0	0	1	1	0	2
TOTAL	48	49	19	283	52	84	33	32	20	70	45	735

VA DISTRICTS — WORK — WED., 6/17/92

MD/DC	12	13	14	15	16	17	18	19	20	21	TOTALS
1	0	3	0	0	1	1	1	1	0	0	7
2	8	5	2	0	1	5	2	4	0	1	28
3	3	3	2	2	4	2	1	2	1	2	22
H 4	1	0	0	1	2	3	1	1	0	0	9
O 5	19	15	5	3	9	7	8	4	6	0	76
M 6	2	6	0	2	1	2	3	2	0	0	18
E 7	32	12	6	8	5	19	4	4	2	3	95
8	0	0	0	0	0	1	0	0	0	0	1
9	28	10	8	12	2	6	5	1	0	1	73
10	83	35	26	48	17	23	13	5	3	7	260
11	0	0	0	0	0	0	0	0	0	0	0
TOTAL	176	89	49	76	42	69	38	24	12	14	589

NOTE: THESE TABLES ARE TRANSPOSED FROM THE WOODROW WILSON BRIDGE LICENSE PLATE SURVEY WHICH WAS CONDUCTED ON THE DAYS NOTED ABOVE BETWEEN 11 AM & 7 PM.

DISTRICTS FOR THE BELTWAY TRANSIT STUDY

MARYLAND/DC DISTRICTS
1 NE & NW DC
2 US 50 TO MD 4 INSIDE BELTWAY
3 MD 210 INSIDE BELTWAY
4 BOLLING AFB
5 MONT. CO. & NORTH. P.G. CO.
6 SUITLAND FEDERAL CENTER
7 US 50 TO MD 4 OUT OF BELTWAY
8 ANDREWS AFB
9 MD 5 OUTSIDE OF BELTWAY
10 MD 210 OUT BELT & CHARLES CO.
11 WASH. NAVY YARD & FT. McNAIR

VIRGINIA DISTRICTS
12 ALEX/CRYSTAL CITY
13 EISENHOWER/VAN DORN
14 ANNANDALE
15 ARLINGTON/McLEAN
16 US 1 OUT & MT. VERNON
17 FAIRFAX, LOUDOUN & P.W. CO.s
18 I-95 TRAF. SHED IN FAIRFAX CO.
19 FORT BELVOIR
20 I-95 TRAF. SHED IN P.W. CO.
21 TYSONS CORNER

JWL 10/15/92

least three times larger than those attracted by the next highest district in Maryland. About one quarter of these trips were produced by the district comprised of Mount Vernon, Rose Hill, and Huntington (District 16).

In Virginia, the district attracting the largest number of home-to-work trips was the district consisting of Alexandria and Crystal City (District 12). This volume of trips was nearly twice as large as those attracted by the next highest district in Virginia. More than half of these trips originated in the district comprised of the MD Route 210 traffic shed extending to Waldorf and La Plata in Charles County (District 10).

The Simulation predicts a relatively high tripmaking demand between Districts 10 and 12 (See Table 2.) It does not show a level of demand between Districts 16 and 4 comparable to that shown by the License Plate Survey.

The reason for the high level of trip demand between Districts 16 and 4 appears to be attributable to a possible bias by the government (military) employees in District 4 towards living in Virginia. This bias is discussed later in this Report.

IV. PROPOSED BUS ROUTES

A. Westbound Bus Route A

Based on the previously described analyses, the Study Team recommended examination of a westbound bus route via the Beltway across the Woodrow Wilson Bridge between the Oxon Hill Park-and-Ride Lot (District 10) and the King Street Metrorail Station (District 12). This route was designated Route A.

From the standpoint of phased implementation, Route A was the best westbound route for the following reasons:

(1) It would address the home-to-work demand between Districts 10 and 12, which was identified as producing the largest number of trips westbound across the Wilson Bridge from a Maryland District to a Virginia District.

(2) It could possibly attract those residents of the MD 210 traffic shed (District 10), identified in the WMATA Study, using the Huntington Metrorail Station or the Alexandria Metrorail Stations to access other Districts in the Metro Region.

(3) It had the shortest distance between a Maryland residential district and a Virginia employment district. As a result, it would have a lower cost than any other home-to-work bus route between Maryland and Virginia.

TABLE 2

BELTWAY TRANSIT STUDY

1995 COG TRAVEL SIMULATION
HOME TO WORK PERSON TRIPS

MD/DC DISTRICTS — WORK

VA DIST.	1	2	3	4	5	6	7	8	9	10	11	TOTALS
12	11179	445	188	113	1067	193	142	59	58	108	597	14147
13	6910	271	114	68	685	129	89	39	45	79	353	8780
H 14	15309	524	211	125	2260	229	169	70	74	129	669	19766
O 15	36100	1031	414	249	4925	404	317	124	118	177	1368	45224
M 16	16577	809	356	191	1676	436	295	171	185	346	895	21936
E 17	44401	1254	496	281	12403	569	390	180	198	349	1502	62021
18	10620	447	185	101	1398	228	156	83	91	171	516	13993
19	306	17	6	5	38	7	6	3	4	8	15	412
20	14831	590	245	133	1891	311	194	108	122	205	703	19330
TOTAL	156231	5386	2213	1263	26342	2504	1755	834	894	1571	6616	205607

VA DISTRICTS — WORK

MD/DC	12	13	14	15	16	17	18	19	20	TOTALS
1	5387	1134	1178	10804	365	2124	376	36	103	21505
2	3499	730	634	4935	281	782	242	29	67	11196
3	1974	470	351	2565	205	454	162	20	44	6244
H 4	91	19	16	125	7	18	6	1	2	284
O 5	8927	1955	2774	19403	642	11858	903	85	254	46798
M 6	807	198	145	1009	86	189	72	10	21	2533
E 7	2146	505	412	2954	218	496	177	25	44	6975
8	57	15	10	70	8	14	5	1	2	179
9	822	243	150	918	119	209	93	14	25	2591
10	2652	857	493	2766	424	715	323	45	85	8358
11	422	85	75	593	29	84	28	3	9	1325
TOTAL	26781	6206	6236	46139	2380	16940	2384	268	653	107986

DISTRICTS FOR THE BELTWAY TRANSIT STUDY

MARYLAND/DC DISTRICTS
1 NE & NW DC
2 US 50 TO MD 4 INSIDE BELTWAY
3 MD 210 INSIDE BELTWAY
4 BOLLING AFB
5 MONT. CO. & NOR. P.G. CO.
6 SUITLAND FEDERAL CENTER
7 US 50 TO MD 4 OUT OF BELTWAY
8 ANDREWS AFB
9 MD 5 OUTSIDE OF BELTWAY
10 MD 210 OUT BELT & CHARLES CO.
11 WASH. NAVY YARD & FT. McNAIR

VIRGINIA DISTRICTS
12 ALEX/CRYSTAL CITY
13 EISENHOWER/VAN DORN
14 ANNANDALE
15 ARLINGTON/McLEAN
16 US 1 OUT & MT. VERNON
17 FAIRFAX, LOUDOUN & P.W. CO.s
18 I-95 TRAF. SHED IN FAIRFAX CO.
19 FORT BELVOIR
20 I-95 TRAF. SHED IN P.W. CO.

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B. Westbound Bus Route B

Westbound Bus Route B evolved as an extension of Bus Route A. Rather than ending Route A at the King Street Metrorail Station, Route B continues service along Duke Street, Van Dorn Street, and Edsall Road to the Shirley Industrial Park.

C. Eastbound Bus Route C

The Beltway Transit Study Team also recommended examination of a bus route via the Beltway between the Huntington Metrorail Station (Huntington) on the yellow line and the employment centers located along the I-295 corridor (District 4: Naval Station Anacostia, Bolling AFB, Naval Research Lab, Blue Plains, and D.C. Village) for phased implementation as part of the Beltway Transit Study.

Following the meeting and upon further reflection, the proposed route was extended to the Anacostia Metrorail Station on the Green Line. This appeared to be consistent with the legislative mandate that the proposed transit service link, among other things, a network of Metrorail stations. This route was designated Route C.

From the standpoint of phased implementation, Route C between the Huntington Metrorail Station to the Anacostia Metrorail Station through the I-295 corridor was the best eastbound route for the following reasons:

(1) The I-295 corridor (District 4) is a compact employment center. The license plate survey indicated that it was the destination of more vehicles, eastbound or westbound, crossing the Wilson Bridge than any other district.

(2) It is not directly served by radial transit from areas outside of the Beltway in either Maryland or Virginia.

(3) While the home-end side (District 16: Huntington, Rose Hill, Mount Vernon) of the work trips is not densely populated, the existing bus lines serving the Huntington Metrorail Station could collect this demand and transfer it to a bus route destined to the I-295 corridor.

(4) It is the shortest route between a Virginia Metrorail Station/Park-and-Ride Lot and a Maryland Metrorail station. As a result, it would have a lower cost than any other eastbound home-to-work bus route between Virginia and Maryland.

Routes A and C were combined to form Route A-C. Combining the routes eliminated busses crossing the Wilson Bridge empty while returning to their points of origin.

Figures 2 and 3 depict Route A-C in the a.m. and p.m. peak periods.

D. Eastbound Bus Route D

Upon review of the data for Bus Routes A and C, the Study Team agreed that ridership estimates did not appear to justify implementation of either Route A, C, or A-C. Furthermore Route C, which provided service between the Huntington and Anacostia Metrorail Stations, appeared to run counter to the local jurisdictions' policy of not implementing transit routes which compete with existing transit routes; i.e., Huntington to Anacostia via a transfer at L'Enfant Plaza.

Subsequently, Route D was developed. Route D proposed provision of service between a free park-and-ride lot located in the vicinity of Springfield Mall and District 4, the employment centers along the I-295 corridor. Figures 4 and 5 depict Route A-D in the a.m. and p.m. peak periods. Figures 6 and 7 depict Route B-D in the a.m. and p.m. peak periods.

V. PROJECTED RIDERSHIP

Forecasts of ridership were prepared for the MD to VA (westbound) bus routes and the VA to MD (eastbound) bus routes. Table 3 lists the projected ridership for Routes A, B, C, and D. An explanation of the derivation of these estimates follows Table 3.

TABLE 3
BUS ROUTE RIDERSHIP PROJECTIONS

	Westbound		Eastbound	
	Route A	Route B	Route C	Route D
One-Way Ridership	247	332	162	400

A. Development of Westbound Projections

1. Bus Route A

There would appear to be several sources of riders for westbound Bus Route A between the Oxon Hill Park-and-Ride Lot and the King Street Metrorail Station:

- Persons traveling from homes in MD or DC (138) across the Woodrow Wilson Bridge to work in Alexandria/Crystal City (District 12). Table 4, which follows Figure 7, details this projection.

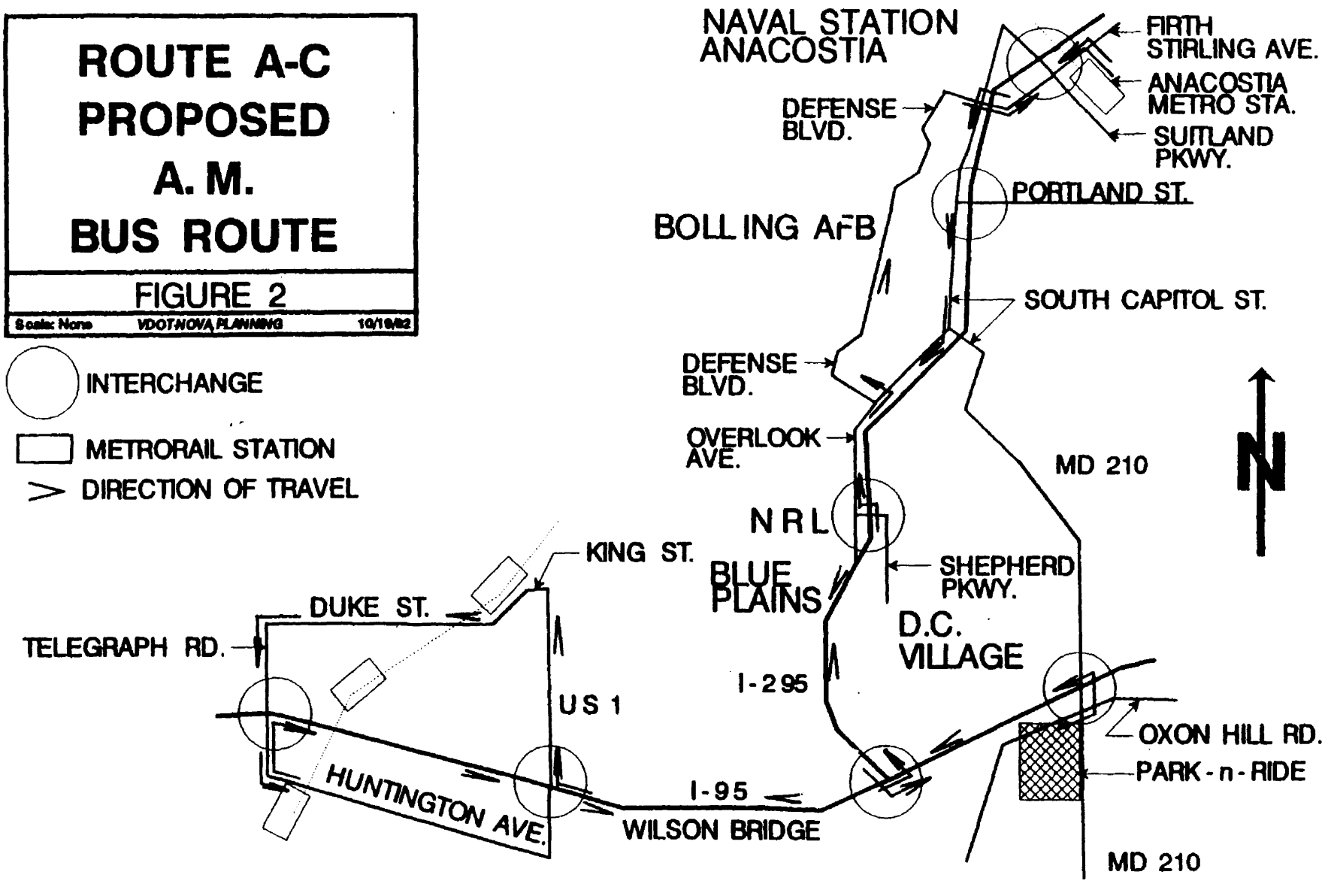
- Persons traveling from homes in MD or DC (59) across the Woodrow Wilson Bridge to work in Pentagon/Rosslyn/Arlington/McLean (District 15). This projection is also contained in Table 4.

BELTWAY TRANSIT STUDY

ROUTE A-C PROPOSED A. M. BUS ROUTE

FIGURE 2

Scale: None VDOT-NOVA PLANNING 10/19/82

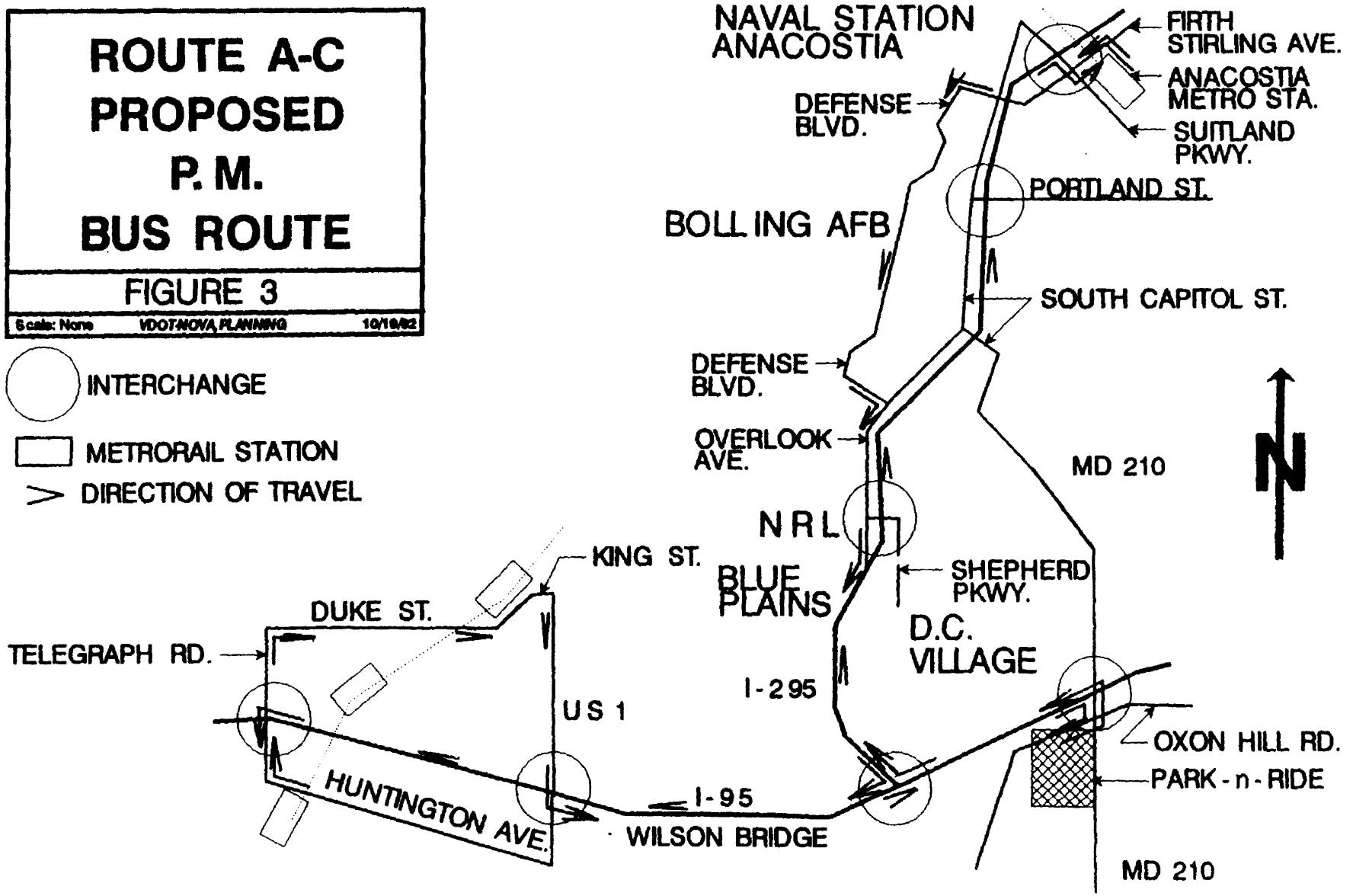


BELTWAY TRANSIT STUDY

ROUTE A-C PROPOSED P.M. BUS ROUTE

FIGURE 3

Scale: None VDOT-NOVA PLANNING 10/19/82

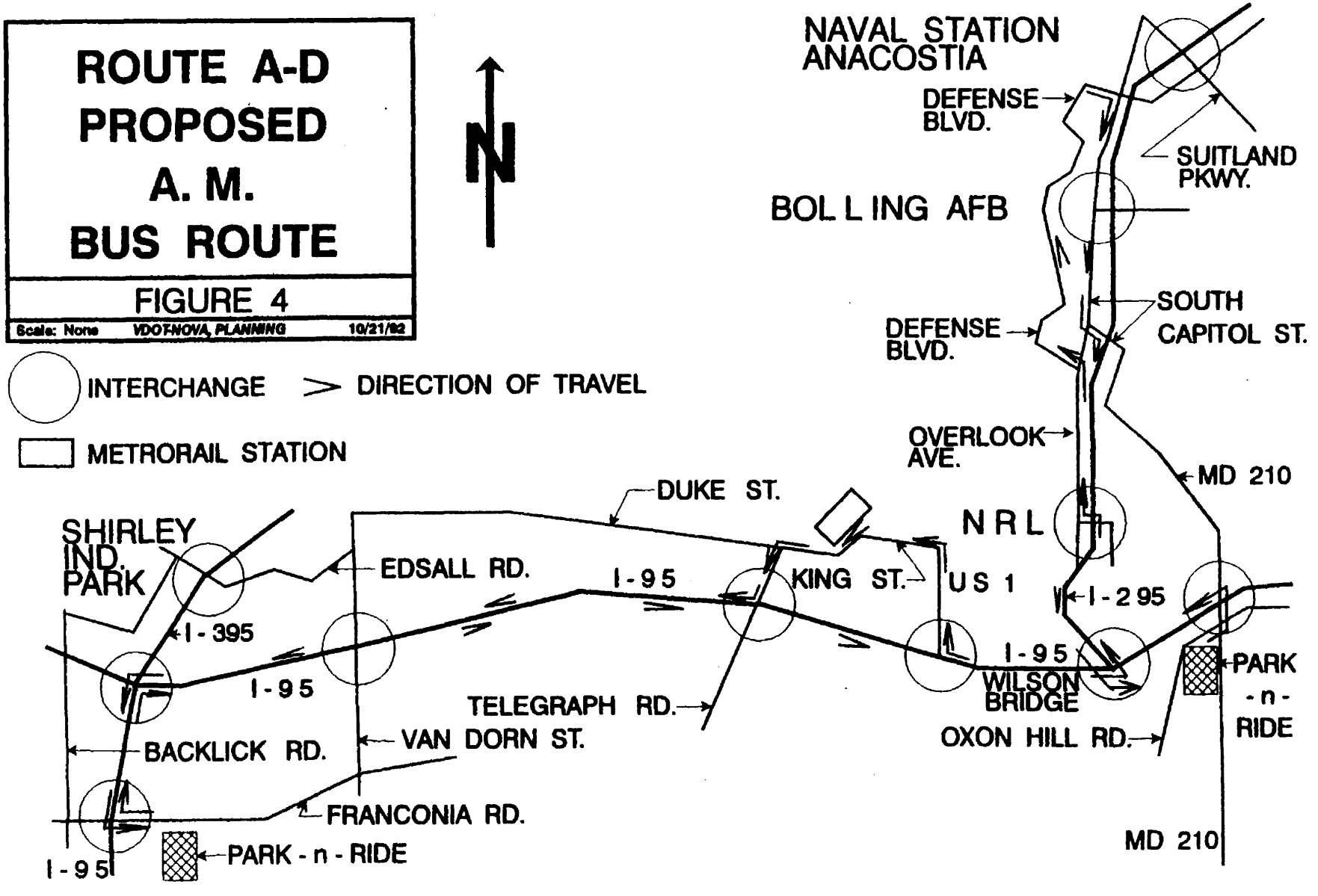


BELTWAY TRANSIT STUDY

ROUTE A-D PROPOSED A. M. BUS ROUTE

FIGURE 4

Scale: None VDOT-NOVA, PLANNING 10/21/82

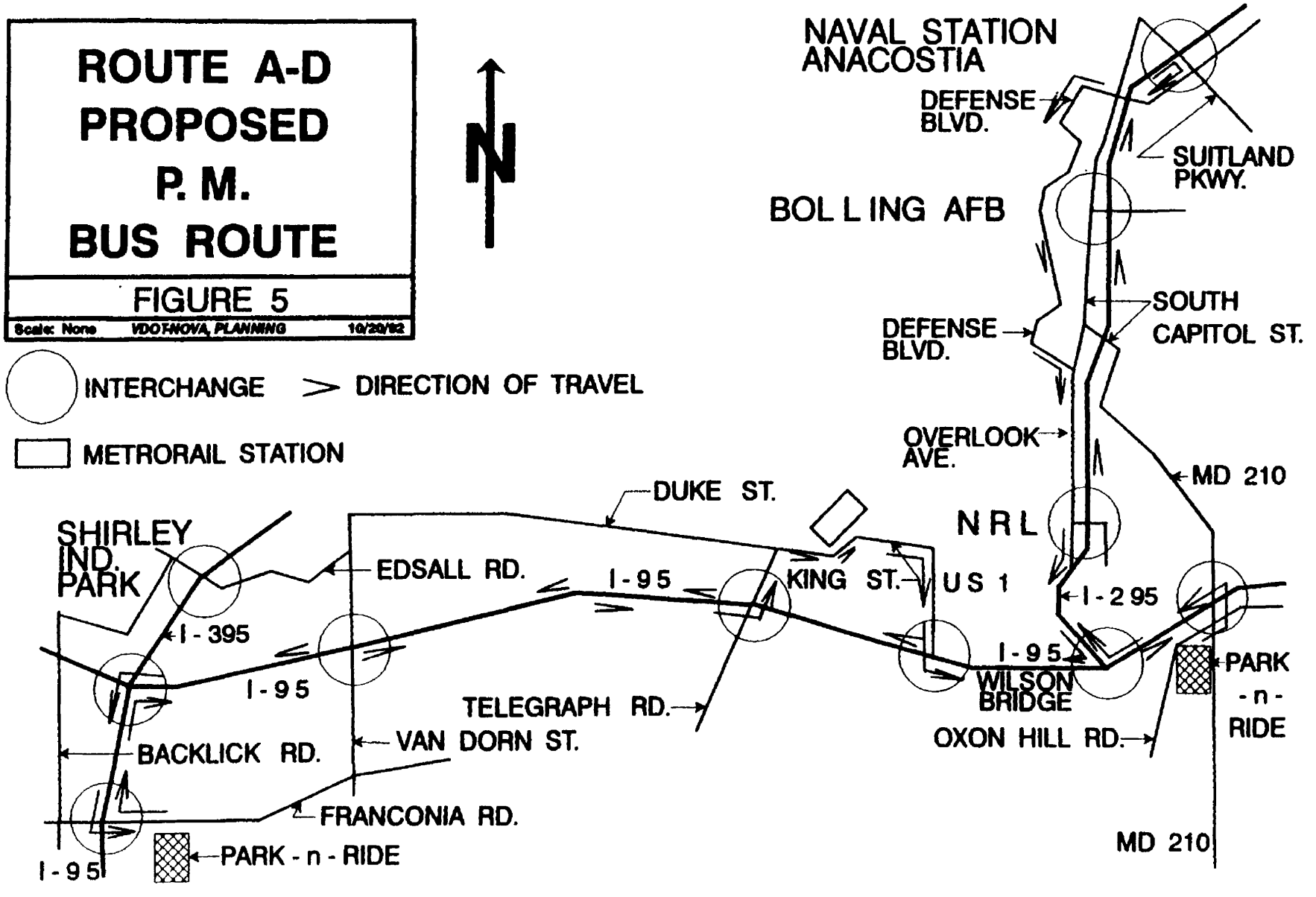


BELTWAY TRANSIT STUDY

ROUTE A-D PROPOSED P. M. BUS ROUTE

FIGURE 5

Scale: None VDOT/NOVA, PLANNING 10/20/82

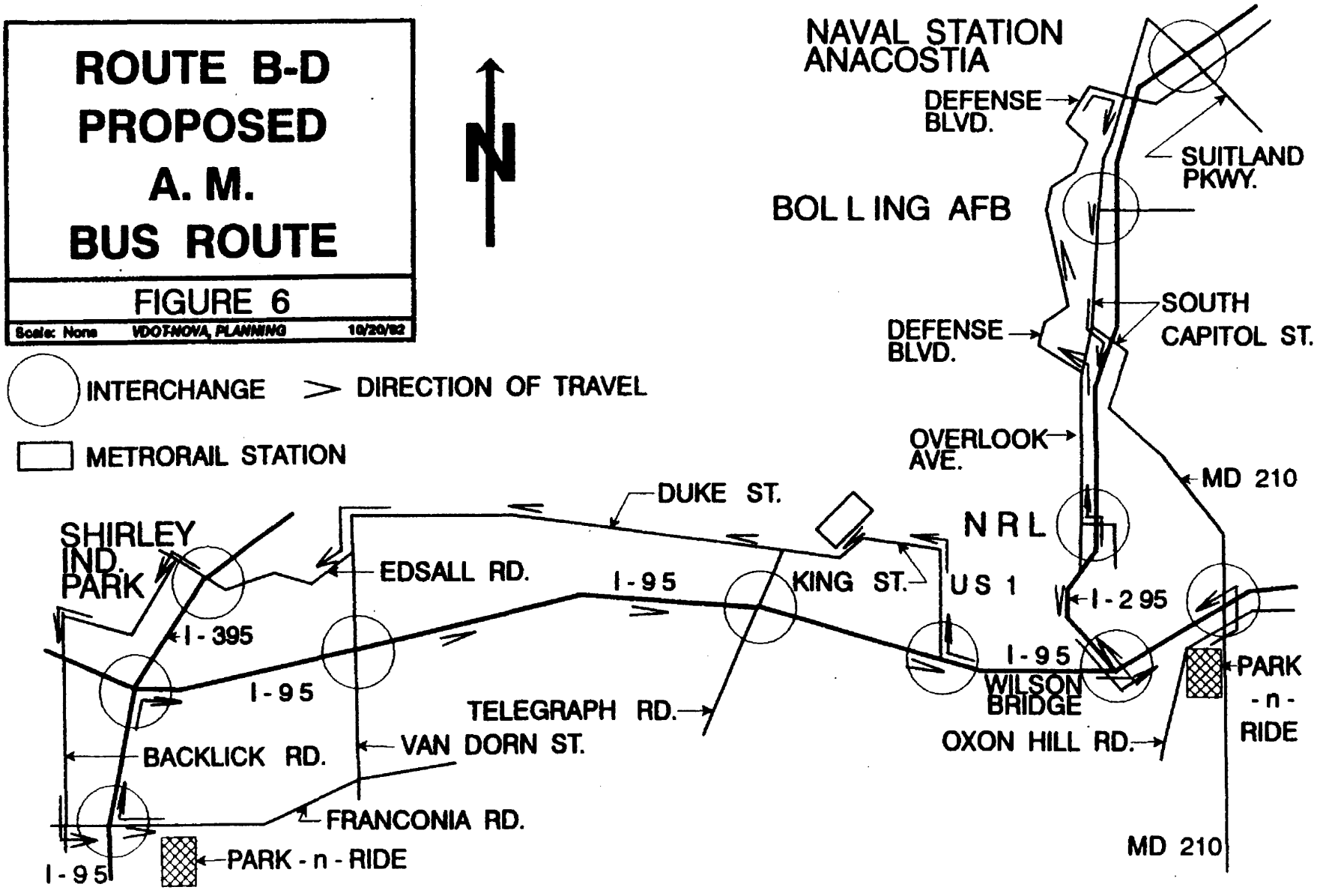


BELTWAY TRANSIT STUDY

ROUTE B-D PROPOSED A. M. BUS ROUTE

FIGURE 6

Scale: None VDOT-NOVA, PLANNING 10/20/82



BELTWAY TRANSIT STUDY

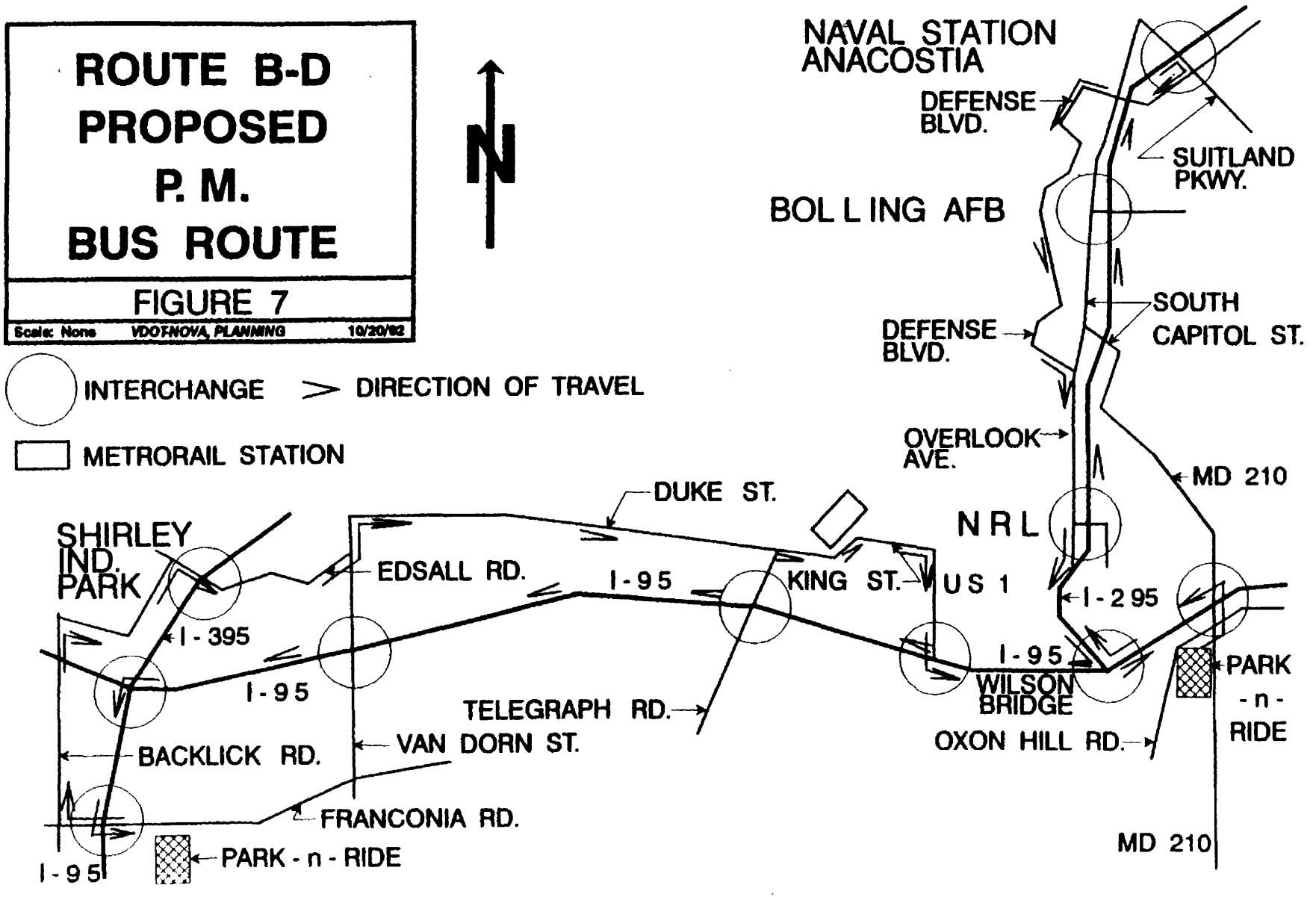


TABLE 4

BELTWAY TRANSIT STUDY

BUS ROUTE A - RIDERSHIP PROJECTIONS

COL. 1 HOME TO WORK	COL. 2 SURV. TRIPS	COL. 3 EXP. FACTOR	COL. 4 TOTAL VEH.	COL. 5 OCCUP. FACTOR	COL. 6 PERS. TRIPS	COL. 7 WALK FACTOR	COL. 8 MODE SPLIT	COL. 9 BUS RIDERS
1-12	0	17.8	0	1.16	0	0.59	0.00	0
1-15	0	17.8	0	1.16	0	0.55	0.00	0
2-12	8	17.8	142	1.16	165	0.59	0.05	5
2-15	0	17.8	0	1.16	0	0.55	0.05	0
3-12	3	17.8	53	1.16	62	0.59	0.08	3
3-15	2	17.8	36	1.16	41	0.55	0.08	2
4-12	1	17.8	18	1.16	21	0.59	0.00	0
4-15	1	17.8	18	1.16	21	0.55	0.00	0
5-12	19	17.8	338	1.16	392	0.59	0.05	12
5-15	3	17.8	53	1.16	62	0.55	0.03	1
6-12	2	17.8	36	1.16	41	0.59	0.05	1
6-15	2	17.8	36	1.16	41	0.55	0.05	1
7-12	32	17.8	570	1.16	661	0.59	0.05	19
7-15	8	17.8	142	1.16	165	0.55	0.05	5
8-12	0	17.8	0	1.16	0	0.59	0.00	0
8-15	0	17.8	0	1.16	0	0.55	0.00	0
9-12	28	17.8	498	1.16	578	0.59	0.05	17
9-15	12	17.8	214	1.16	248	0.55	0.05	7
10-12	83	17.8	1477	1.16	1714	0.59	0.08	81
10-15	48	17.8	854	1.16	991	0.55	0.08	44
11-12	0	17.8	0	1.16	0	0.59	0.00	0
11-15	0	17.8	0	1.16	0	0.55	0.00	0
							TOTAL	197

DISTRICTS (SEE FIGURE 1)

1 NE & NW DC
2 US 50 TO MD 4 INSIDE BELTWAY
3 MD 210 INSIDE BELTWAY
4 BOLLING AFB
5 MONT. CO. & NOR. P.G. CO.
6 SUITLAND FEDERAL CENTER
7 US 50 TO MD 4 OUT OF BELTWAY
8 ANDREWS AFB
9 MD 5 OUTSIDE OF BELTWAY
10 MD 210 OUT BELT & CHARLES CO.
11 WASH. NAVY YARD & FT. McNAIR
12 ALEX/CRYSTAL CITY
15 PENTAGON/ARLINGTON/McLEAN

COLUMN 1 - THE FIRST NUMBER IS A HOME DISTRICT ON THE EAST SIDE OF THE WILSON BRIDGE; THE SECOND IS A WORK DISTRICT ON THE WEST SIDE.

COLUMN 2 - NUMBER OF TRIPS SURVEYED CROSSING THE WILSON BRIDGE ON WED., 6/17/92 (11 AM to 7 PM) GOING FROM WORK TO HOME.

COLUMN 3 - A FACTOR TO EXPAND THE LIMITED NUMBER OF SURVEYED TRIPS TO THE UNIVERSE OF TRIPS CROSSING THE POTOMAC DURING THE SURVEY PERIOD.

COLUMN 4 - TOTAL WESTBOUND WORK TRIPS DURING THE 8 HR OBSERVATION PERIOD. (COL. 2 * COL. 3)

COLUMN 5 - AN OCCUPANCY FACTOR TO EXPAND VEHICLE TRIPS TO PERSON TRIPS.

COLUMN 6 - TOTAL WESTBOUND WORK PERSON TRIPS DURING THE 8 HR. PERIOD. (COL. 4 * COL. 5)

COLUMN 7 - WALKING FACTOR: EMPLOYMENT IN COG ZONES ADJACENT TO METRO STATIONS DIVIDED BY TOTAL EMPLOYMENT FOR THE DISTRICT.

COLUMN 8 - PERCENTAGE OF PERSON TRIPS ASSUMED TO BE ATTRACTED BY THE $0.50 BUS RIDE FROM THE OXON HILL P-n-R LOT TO THE KING ST. METRO. DERIVED FROM MODE SPLIT ESTIMATES AS SHOWN IN COG's "FACT BOOK".

COLUMN 9 - WESTBOUND BUS RIDERS (COL. 6 * 7 * 8).

- Transfer of riders (14) from the existing P13 bus which is labeled as an express bus between the Oxon Hill Park-and-Lot and the Pentagon. To improve the service of the P13 bus, the Beltway Transit Study Team recommended that its stop at Washington and King Streets be eliminated and replaced by a stop at US 1 and King St. on the westbound bus. Elimination of the stop at Washington and King would allow the P13 to improve its delivery time to the Pentagon and could, consequently, increase its ability to attract riders to this destination.

- Mode of access captures (36). Based on analysis of the 1990 Metrorail Passenger Survey, there are approximately 110 people traveling from home in District 10 across the Wilson Bridge to work in Districts other than Districts 12 and 15 who use either the Huntington Metrorail Station or Metrorail stations within Alexandria to access their workplaces. Of these, approximately 8 use taxi service to access Huntington, and approximately 55 auto drivers access Huntington or the Alexandria Metrorail Stations.

  It was assumed that all of the taxi riders and one half of the auto drivers would be captured by the new bus route due to its cost advantage of free parking and $0.50 fare versus a taxi fare or parking fee. This resulted in an additional 36 persons taking the bus.

To summarize, total one-way riders for the proposed westbound Bus Route A between the Oxon Hill Park-and-Ride Lot and the King Street Metrorail Station was estimated to be 247 (138 + 59 + 14 + 36).

2. Bus Route B

As stated earlier in this Report, Bus Route B evolved as an extension of Bus Route A. Rather than ending Route A at the King Street Metrorail Station, Route B proposed continuation of service along Duke Street, Van Dorn Street, and Edsall Road to the Shirley Industrial Park.

As an extension of Route A, it should continue to attract the same riders as Route A, as well as, riders attracted by the additional service. Table 5 on the following page details this projection. It is predicted that an additional 85 people could board the bus in Oxon Hill due to the extension of service offered by Route B. Total one-way boardings for Route B are estimated to be 332.

TABLE 5

BELTWAY TRANSIT STUDY

BUS ROUTE B - RIDERSHIP PROJECTIONS

COL. 1 HOME T WORK	COL. 2 SURV. TRIPS	COL. 3 EXP. FACTOR	COL. 4 TOTAL VEH.	COL. 5 OCCUP. FACTOR	COL. 6 PERS. TRIPS	COL. 7 WALK FACTOR	COL. 8 MODE SPLIT	COL. 9 BUS RIDERS
1-13	3	17.8	53	1.16	62	0.61	0.00	0
1-14	0	17.8	0	1.16	0	0.16	0.00	0
1-18	0	17.8	0	1.16	0	0.12	0.00	0
2-13	5	17.8	89	1.16	103	0.61	0.05	3
2-14	2	17.8	36	1.16	41	0.16	0.05	0
2-18	2	17.8	36	1.16	41	0.12	0.05	0
3-13	3	17.8	53	1.16	62	0.61	0.08	3
3-14	2	17.8	36	1.16	41	0.16	0.08	1
3-18	1	17.8	18	1.16	21	0.12	0.08	0
4-13	0	17.8	0	1.16	0	0.61	0.00	0
4-14	0	17.8	0	1.16	0	0.16	0.00	0
4-18	1	17.8	18	1.16	21	0.12	0.00	0
5-13	15	17.8	267	1.16	310	0.61	0.05	9
5-14	5	17.8	89	1.16	103	0.16	0.05	1
5-18	8	17.8	142	1.16	165	0.12	0.05	1
6-13	6	17.8	107	1.16	124	0.61	0.05	4
6-14	0	17.8	0	1.16	0	0.16	0.05	0
6-18	3	17.8	53	1.16	62	0.12	0.05	0
7-13	12	17.8	214	1.16	248	0.61	0.05	8
7-14	6	17.8	107	1.16	124	0.16	0.05	1
7-18	4	17.8	71	1.16	83	0.12	0.05	0
8-13	0	17.8	0	1.16	0	0.61	0.05	0
8-14	0	17.8	0	1.16	0	0.16	0.05	0
8-18	0	17.8	0	1.16	0	0.12	0.05	0
9-13	10	17.8	178	1.16	206	0.61	0.05	6
9-14	8	17.8	142	1.16	165	0.16	0.05	1
9-18	5	17.8	89	1.16	103	0.12	0.05	1
10-13	35	17.8	623	1.16	723	0.61	0.08	35
10-14	26	17.8	463	1.16	537	0.16	0.08	7
10-18	13	17.8	231	1.16	268	0.12	0.08	3
11-13	0	17.8	0	1.16	0	0.61	0.00	0
11-14	0	17.8	0	1.16	0	0.16	0.00	0
11-18	0	17.8	0	1.16	0	0.12	0.00	0
							TOTAL	85

COLUMN 1 - THE FIRST NUMBER IS A HOME DISTRICT ON THE EAST SIDE OF THE WILSON BRIDGE; THE SECOND IS A WORK DISTRICT ON THE WEST SIDE.

COLUMN 2 - NUMBER OF TRIPS SURVEYED CROSSING THE WILSON BRIDGE ON WED., 6/17/92 (11 AM to 7 PM) GOING FROM WORK TO HOME.

COLUMN 3 - A FACTOR TO EXPAND THE LIMITED NUMBER OF SURVEYED TRIPS TO THE UNIVERSE OF TRIPS CROSSING THE POTOMAC DURING THE SURVEY PERIOD.

COLUMN 4 - TOTAL WESTBOUND WORK TRIPS DURING THE 8 HR OBSERVATION PERIOD. (COL. 2 * COL. 3)

COLUMN 5 - AN OCCUPANCY FACTOR TO EXPAND VEHICLE TRIPS TO PERSON TRIPS.

COLUMN 6 - TOTAL WESTBOUND WORK PERSON TRIPS DURING THE 8 HR. PERIOD. (COL. 4 * COL. 5)

COLUMN 7 - WALKING FACTOR: EMPLOYMENT IN COG ZONES ADJACENT TO METRO STATIONS DIVIDED BY TOTAL EMPLOYMENT FOR THE DISTRICT.

COLUMN 8 - PERCENTAGE OF PERSON TRIPS ASSUMED TO BE ATTRACTED BY THE $0.50 BUS RIDE FROM THE OXON HILL P-n-R LOT TO THE KING ST. METRO. DERIVED FROM MODE SPLIT ESTIMATES AS SHOWN IN COG's "FACT BOOK".

COLUMN 9 - WESTBOUND BUS RIDERS (COL. 6 * 7 * 8).

B. Development of Eastbound Projections
Contact with the employers in the I-295 corridor (District 4) yielded the information displayed in Table 6:

TABLE 6
EMPLOYEES FROM DISTRICT 4 LIVING IN VIRGINIA

EMPLOYER	SOURCE	EMPLOYEES	IN VA	DIST 16	DIST 18*
D.C. Village	Phone Call	1,000	63	NA	NA
Blue Plains	Phone Call	917	41	NA	NA
Naval Research Lab	Zip Code Survey (1990)	3,587	1,172	286	113
Naval Station Anacostia	Transit Survey (1991)	1,985	971	119	59
Bolling AFB	Base Comp. Plan	6,883	4,161	250	427
	TOTAL	14,372	6,408	655	599

* Living in District 18 in the Franconia Road traffic shed. District 18 was defined as the I-95 traffic shed between the Capital Beltway and the Prince William County Line.

NA Not available.

The high percentage of employees from District 4 (primarily Department of Defense (DoD) installations) residing in Virginia is consistent with a previous pattern noted at the Pentagon.

3. Bus Route C
Transportation Facts and Forecasts for the Washington Metropolitan Region, prepared by COG in January, 1989, shows a transit modal split factor of 7% for Fairfax City/County to D.C. non-core in Table III-15. Using this factor, it is projected that 46 (655 x 7%) persons from District 16 would ride a bus between Huntington Station and the I-295 corridor (District 4).

Similarly, it is projected that 42 (599 x 7%) persons from the Franconia Road traffic shed within District 18 would also use the eastbound bus destined to District 4. The Franconia Road traffic shed within District 18 has been singled out due to the relatively good access which Franconia Road provides to the parking facility located at the Huntington Metrorail Station.

Extrapolation of the data from the 1992 License Plate Survey indicates that there are approximately 340 persons traveling across the Wilson Bridge from homes in District 16 (275) and the Franconia Road traffic shed in District 18 (65) to work in District 11. Using the aforementioned 7% and knowing that the eastbound bus is a transit service not accounted

for in the modeling process, it is estimated that 24 persons would switch mode from driving their automobiles from home in either District 16 or the Franconia Road traffic shed in District 18 to riding transit via the Beltway to work in District 11.

The 1995 COG Travel Simulation predicts that there would be 118 persons riding transit from District 16 (Huntington Station) to the area (District 11) served by the Waterfront and Washington Naval Yard Metrorail Stations on the Green Line. Ridership figures for the all Metrorail route from Huntington Station to the Green Line Stations via a transfer at the L'Enfant Plaza Station are not available from the 1990 Passenger Survey since the Green Line did not open until the end of 1991.

Travel times would be about 30 minutes between the Huntington and Naval Yard Metrorail Stations via either route: all-Metro, Huntington to L'Enfant to Naval Yard or bus-Metro, Huntington to Anacostia to Naval Yard. Out-of-pocket-dollar costs, $2.00, are anticipated to be equal, if the fare to be charged for the bus ride from Huntington to Anacostia is $1.00.

Based on the lack of any apparent advantage for either route between Districts 16 and 11, it is predicted that 45% of the simulated riders (50, 118 x 45%) would ride the eastbound bus from Huntington Station, access the Anacostia Station, and travel via Metro to the Naval Yard or Waterfront Metrorail Stations.

Total one-way riders for proposed eastbound Bus Route C between the Huntington Metrorail Station to the Anacostia Metrorail Station through the I-295 corridor was estimated to be 162.

4. Bus Route D

Route D proposed provision of service between a free park-and-ride lot located in the vicinity of Springfield Mall and District 4, the employment centers along the I-295 corridor.

It is estimated that there are approximately 4,000 employees destined to District 4 passing through the I-95/I-495 interchange every morning. It was estimated that provision of transit service via Bus Route D would attract 10%, or 400, of these commuters.

VI. PROJECTED SCHEDULES

Following discussions with representatives of WMATA and a local/private operator, the constraints listed below were placed on the development of bus routes:

- Schedules should be tight; i.e., there should be little slack time built into a schedule.
- Layovers should last from four to six minutes.
- Headways should be approximately 15 minutes in order to ensure that a person missing a bus would not wait long to catch the next bus.
- There should be a "Timed" transfer between the proposed bus and the P13 bus. For purposes of this study, the length of time for a "timed" transfer was defined as a maximum of two minutes between the arrival/departure of one bus and the arrival/departure of another.
- Driving time and mileage should be multiplied by 20% to account for deadheads and platform time.

On Tuesday, September 1st; Wednesday, September 2nd; and Tuesday, September 15th during the a.m. and p.m. peak hours, travel time studies were conducted between the various locations. Assumed run times and distances between the transit sites are displayed for Bus Routes A-C, A-D, and B-D on Figures 8 and 9, 10 and 11, and 12 and 13 for the a.m. and p.m. peaks, respectively; as are the proposed transit schedules.

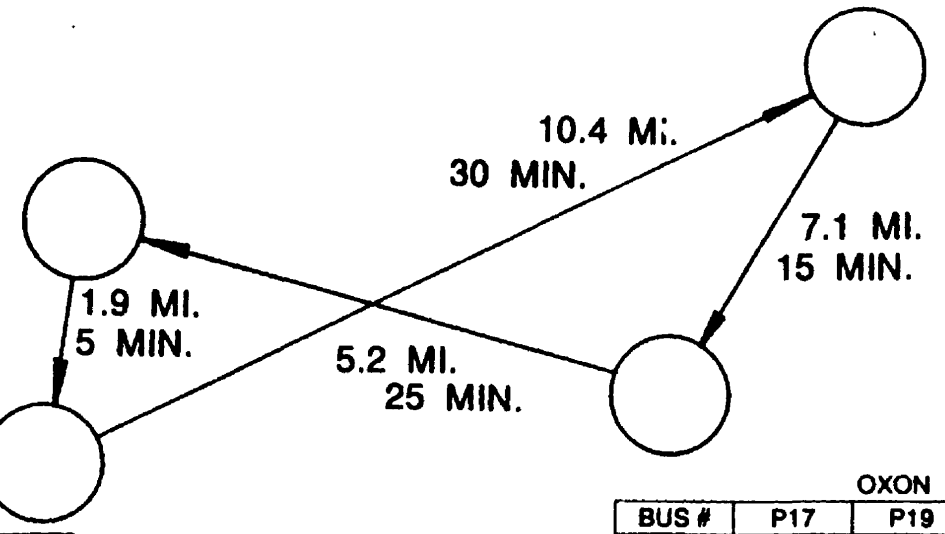
Figure 14 is reproduced from the *Bolling Air Force Base Comprehensive Plan*. The information displayed on this figure is taken to be representative of the peak periods for employees arriving and departing for all of the DoD facilities in the I-295 corridor. Based on this information, service through the I-295 employment centers was scheduled to coincide with peak arrival and departure times.

VII. PROJECTED OPERATING COSTS AND REVENUES

Using cost data obtained from WMATA and a local/private operator (the Fairfax County Connector), the cost information displayed in Table 7, which follows Figure 14, was developed.

BELTWAY TRANSIT STUDY

FIGURE 8
ROUTE A-C: A.M. BUS ROUTE SCHEDULE



KING ST. METRO STATION

	BUS #	ARR/DPT
← OUT	E	7:00
	A	7:15
	B	7:30
	C	7:45
	D	8:00
	E	8:25
← OUT	A	8:40
← OUT	B	8:55

ANACOSTIA METRO STATION

BUS #	ARR/DPT	
A	6:30	
B	6:45	
C	7:00	
D	7:15	
E	7:40	
A	7:55	
B	8:10	
C	8:25	OUT →
D	8:40	OUT →
E	9:05	OUT →

HUNTINGTON METRO STATION

	BUS #	ARRIVE	DEPART
IN →	A	5:55	6:00
IN →	B	6:10	6:15
IN →	C	6:25	6:30
IN →	D	6:40	6:45
	E	7:05	7:10
	A	7:20	7:25
	B	7:35	7:40
	C	7:50	7:55
	D	8:05	8:10
	E	8:30	8:35

FIVE MINUTE LAYOVERS

COMPLETE CYCLE; i.e., HUNTINGTON TO ANACOSTIA TO OXON HILL TO KING ST. & BACK TO HUNTINGTON REQUIRES 85 MIN.; W/ LAYOVERS.

OXON HILL P-n-R

	BUS #	P17	P19	ARRIVE	P13	DEPART
		6:08				
		6:18				
IN →	E	6:30	6:30	6:30	6:31	6:35
	A	6:43		6:45		6:50
			6:55			
	B	7:00		7:00	7:01	7:05
		7:05				
	C		7:15	7:15		7:20
		7:25				
	D	7:30	7:35	7:30		7:35
	E	7:55	8:00	7:55	7:56	8:00
	A	8:15		8:10		8:15
	B	8:25		8:25		8:30

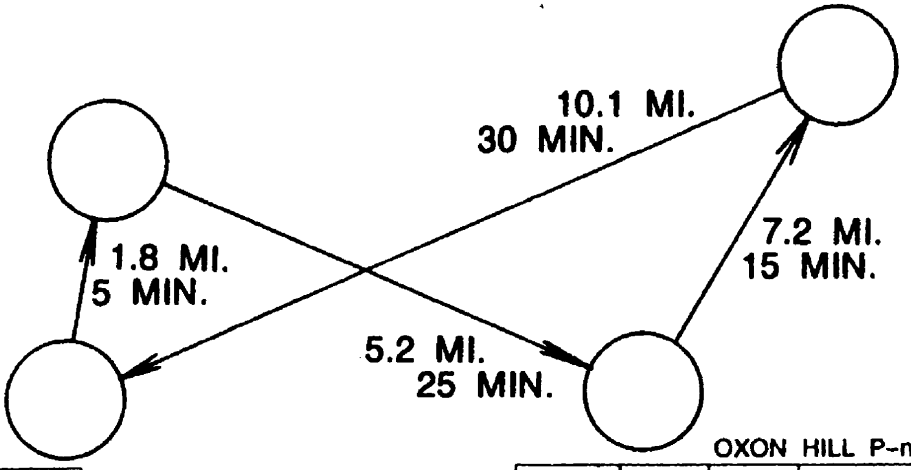
XXX TIMED TRANSFER
FIVE MINUTE LAYOVERS

A, B, C, D & E ARE THE FIVE BUSSES RUNNING THE ROUTE.

JWL
10/19/92

BELTWAY TRANSIT STUDY

FIGURE 9
ROUTE A-C: P.M. BUS ROUTE SCHEDULE



KING ST. METRO STATION

BUS #	ARR/DPT
D	3:55
E	4:10
A	4:25
B	4:40
C	4:55
D	5:15
E	5:30
A	5:45
B	6:00

ANACOSTIA METRO STATION

BUS #	ARR/DPT	
A	2:30	← IN
B	2:45	← IN
C	3:00	← IN
D	3:15	← IN
E	3:30	← IN
A	3:45	
B	4:00	
C	4:15	
D	4:35	
E	4:50	
A	5:05	
B	5:20	
C	5:35	

HUNTINGTON METRO STATION

BUS #	ARRIVE	DEPART	
A	3:00	3:05	BACK TO ANACOSTIA
B	3:15	3:20	BACK TO ANACOSTIA
C	3:30	3:35	BACK TO ANACOSTIA
D	3:45	3:50	
E	4:00	4:05	
A	4:15	4:20	
B	4:30	4:35	
C	4:45	4:50	
D	5:05	5:10	
E	5:20	5:25	COMPLETE CYCLE; i.e.,
A	5:35	5:40	ANACOSTIA TO HUNTINGTON
B	5:50	5:55	TO KING ST. TO OXON
C	6:05		HILL & BACK TO ANACOSTIA

REQUIRES 80 MIN.; W/ LAYOVERS.

← OUT

FIVE MINUTE LAYOVERS

OXON HILL P-n-R

BUS #	P17	P19	ARRIVE	P13	DEPART	
D	4:20		4:15		4:20	
E			4:30		4:35	
A	4:45		4:45	4:51	4:50	
		4:55				
B			5:00		5:05	
	5:10					
C		5:20	5:15		5:20	
				5:29		
D	5:34		5:35		5:40	OUT →
		5:44				
E	5:54		5:50		5:55	OUT →
A		6:04	6:05	6:06	6:10	OUT →
	6:12					
B		6:27	6:20		6:25	OUT →
	6:52					
XXX	TIMED TRANSFER					

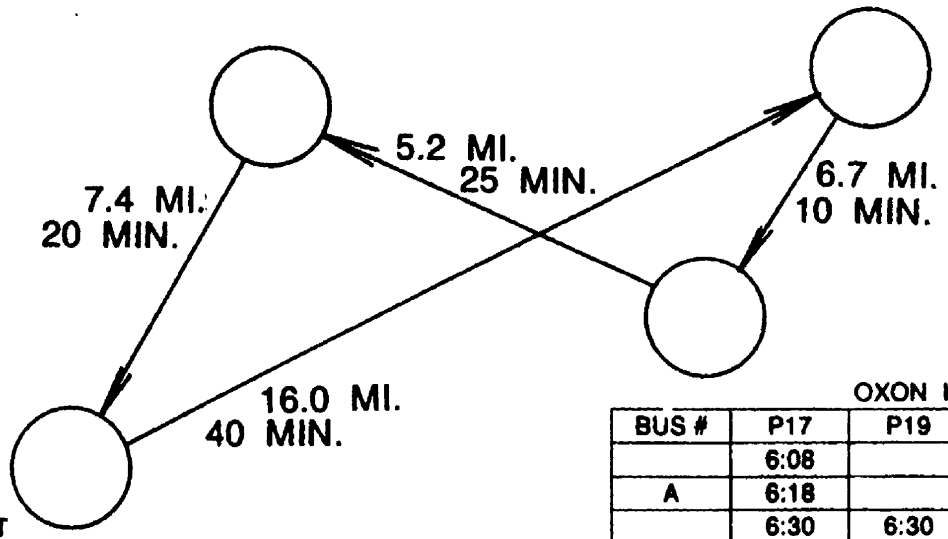
FIVE MINUTE LAYOVERS

A, B, C, D, & E ARE THE FIVE BUSSES RUNNING THE ROUTE.

JWL
10/19/92

BELTWAY TRANSIT STUDY

FIGURE 10
ROUTE A-D: A.M. BUS ROUTE SCHEDULE



KING ST.
METRO STATION

	BUS #	ARR/DPT
	A	6:50
	B	7:05
	C	7:20
	D	7:35
← OUT	E	7:50
← OUT	F	8:05
← OUT	G	8:20
← OUT	A	8:35
← OUT	B	8:50

NORTH GATE
ANAC. NAV. STA.

BUS #	ARR/DPT	
A	6:10	
B	6:25	
C	6:40	
D	6:55	
E	7:10	
F	7:25	
G	7:40	
A	7:55	
B	8:10	
C	8:25	OUT →
D	8:40	OUT →

SPRINGFIELD
PARK-AND-RIDE LOT

	BUS #	ARRIVE	DEPART
IN →	A	5:25	5:30
IN →	B	5:40	5:45
IN →	C	5:55	6:00
IN →	D	6:10	6:15
IN →	E	6:25	6:30
IN →	F	6:40	6:45
IN →	G	6:55	7:00
	A	7:10	7:15
	B	7:25	7:30
	C	7:40	7:45
	D	7:55	8:00

FIVE MINUTE LAYOVERS

A, B, C, D, E, F, & G ARE THE SEVEN BUSSES RUNNING THE ROUTE.

COMPLETE CYCLE; i.e., SPRINGFIELD TO DISTRICT 4 TO OXON HILL TO KING ST. & BACK TO SPRINGFIELD VIA I-95
REQUIRES 105 MIN.; WITH LAYOVERS.

OXON HILL P-n-R

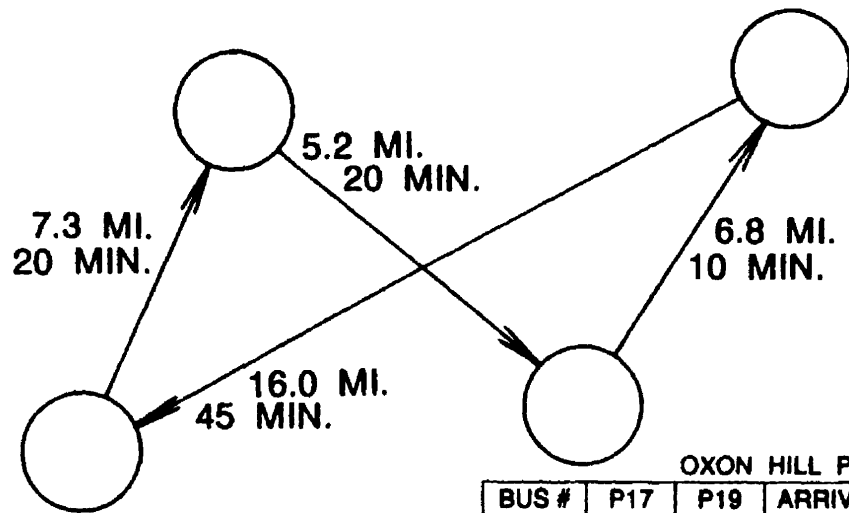
BUS #	P17	P19	ARRIVE	P13	DEPART
	6:08				
A	6:18		6:20		6:25
	6:30	6:30		6:31	
B			6:35		6:40
	6:43				
C		6:55	6:50		6:55
	7:00			7:01	
D	7:05		7:05		7:10
		7:15			
E	7:25		7:20		7:25
	7:30				
F		7:35	7:35		7:40
G	7:55		7:50	7:56	7:55
		8:00			
A			8:05		8:10
	8:15				
B	8:25		8:20		8:25
XXX	TIMED TRANSFER				JWL

FIVE MINUTE LAYOVERS

10/19/92

BELTWAY TRANSIT STUDY

FIGURE 11
ROUTE A-D: P.M. BUS ROUTE SCHEDULE



KING ST.
METRO STATION

BUS #	ARR/DPT
B	3:55
C	4:10
D	4:25
E	4:40
F	4:55
A	5:10
G	5:25
B	5:40
C	5:55
D	6:10

NORTH GATE
ANAC. NAV. STA.

BUS #	ARR/DPT	
A	2:30	← IN
B	2:45	← IN
C	3:00	← IN
D	3:15	← IN
E	3:30	← IN
F	3:45	← IN
A	4:00	
G	4:15	← IN
B	4:30	
C	4:45	
D	5:00	
E	5:15	
F	5:30	

SPRINGFIELD
PARK-AND-RIDE LOT

BUS #	ARRIVE	DEPART	
A	3:15	3:20	BACK TO DISTRICT 4
B	3:30	3:35	
C	3:45	3:50	
D	4:00	4:05	
E	4:15	4:20	
F	4:30	4:35	
A	4:45	4:50	
G	5:00	5:05	
B	5:15	5:20	COMPLETE CYCLE; i.e.,
C	5:30	5:35	DISTRICT 4 TO SPRINGFIELD
D	5:45	5:50	VIA 1-95
E	6:00		TO KING ST. TO OXON
F	6:15		HILL & BACK TO DISTRICT 4

← OUT
← OUT

REQUIRES 105 MIN.; WITH
LAYOVERS.

FIVE MINUTE LAYOVERS
A, B, C, D, E, F, & G ARE THE
SEVEN BUSSES RUNNING THE ROUTE.

OXON HILL P-n-R

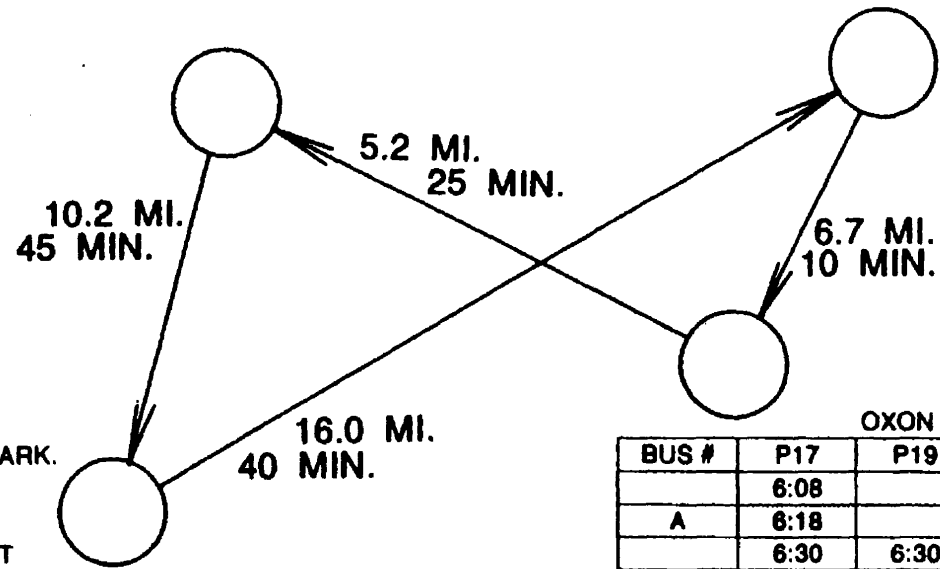
BUS #	P17	P19	ARRIVE	P13	DEPART	
B	4:20		4:15		4:20	
C			4:30		4:35	
D	4:45		4:45	4:51	4:50	
		4:55				
E			5:00		5:05	
	5:10					
F		5:20	5:15		5:20	
A			5:30	5:29	5:35	OUT →
	5:34					
G		5:44	5:45		5:50	OUT →
	5:54					
B		6:04	6:00	6:06	6:05	OUT →
C	6:12		6:15		6:15	OUT →
D		6:27	6:30		6:30	OUT →
	6:52					

XXX TIMED TRANSFER
FIVE MINUTE LAYOVERS

JWL
10/19/92

BELTWAY TRANSIT STUDY

FIGURE 12
ROUTE B-D: A.M. BUS ROUTE SCHEDULE



KING ST.
METRO STATION

	BUS #	ARR/DPT
OUT*	A	6:50
OUT*	B	7:05
OUT*	C	7:20
OUT*	D	7:35
OUT*	E	7:50
OUT*	F	8:05
OUT*	G	8:20
OUT*	H	8:35
OUT*	I	8:50

* FINAL STOP ON THE ROUTE IS THE SHIRLEY INDUSTRIAL PARK.

NORTH GATE
ANAC. NAV. STA.

BUS #	ARR/DPT	
A	6:10	
B	6:25	
C	6:40	
D	6:55	
E	7:10	
F	7:25	
G	7:40	
H	7:55	
I	8:10	
A	8:20	OUT
B	8:35	OUT
C	8:50	OUT

SPRINGFIELD
PARK-AND-RIDE LOT

	BUS #	ARRIVE	DEPART
IN	A	5:25	5:30
IN	B	5:40	5:45
IN	C	5:55	6:00
IN	D	6:10	6:15
IN	E	6:25	6:30
IN	F	6:40	6:45
IN	G	6:55	7:00
IN	H	7:10	7:15
IN	I	7:25	7:30
	A	7:35	7:40
	B	7:50	7:55
	C	8:05	8:10

FIVE MINUTE LAYOVERS
A, B, C, D, E, F, G, H, & I ARE THE NINE BUSSES RUNNING THE ROUTE.

COMPLETE CYCLE; i.e., SPRINGFIELD TO DISTRICT 4 TO OXON HILL TO KING ST. & BACK TO SPRINGFIELD VIA THE SHIRLEY INDUSTRIAL PARK REQUIRES 130 MIN.; WITH LAYOVERS.

OXON HILL P-n-R

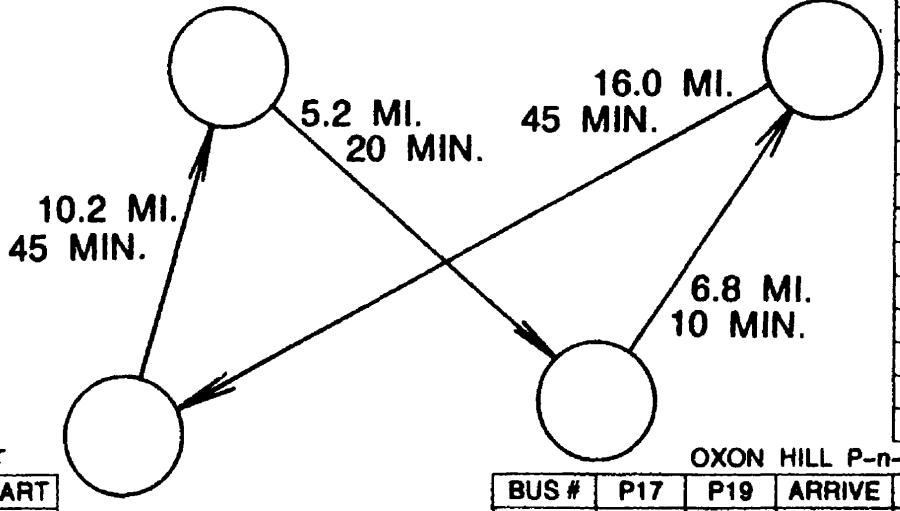
BUS #	P17	P19	ARRIVE	P13	DEPART
	6:08				
A	6:18		6:20		6:25
	6:30	6:30		6:31	
B			6:35		6:40
	6:43				
C		6:55	6:50		6:55
	7:00			7:01	
D	7:05		7:05		7:10
		7:15			
E	7:25		7:20		7:25
	7:30				
F		7:35	7:35		7:40
G	7:55		7:50	7:56	7:55
		8:00			
H			8:05		8:10
	8:15				
I	8:25		8:20		8:25
XXX	TIMED TRANSFER				JWL

FIVE MINUTE LAYOVERS

10/19/92

BELTWAY TRANSIT STUDY

FIGURE 13
ROUTE B-D: P.M. BUS ROUTE SCHEDULE



KING ST.
METRO STATION

BUS #	ARR/DPT
A	4:05
B	4:20
C	4:35
D	4:50
E	5:05
F	5:20
G	5:35
H	5:50
I	6:05

NORTH GATE
ANAC. NAV. STA.

BUS #	ARR/DPT	
A	2:30	← IN
B	2:45	← IN
C	3:00	← IN
D	3:15	← IN
E	3:30	← IN
F	3:45	← IN
G	4:00	← IN
H	4:15	← IN
I	4:30	← IN
A	4:40	
B	4:55	
C	5:10	
D	5:25	

SPRINGFIELD
PARK-AND-RIDE LOT

BUS #	ARRIVE	DEPART	
A	3:15	3:20	
B	3:30	3:35	
C	3:45	3:50	
D	4:00	4:05	
E	4:15	4:20	
F	4:30	4:35	
G	4:45	4:50	
H	5:00	5:05	
I	5:15	5:20	
A	5:25		← OUT
B	5:40		← OUT
C	5:55		← OUT
D	6:10		← OUT

OXON HILL P-n-R

BUS #	P17	P19	ARRIVE	P13	DEPART	
	4:20					
A			4:25		4:30	
B	4:45		4:40		4:45	
				4:51		
C		4:55	4:55		5:00	
D	5:10		5:10		5:15	
		5:20				
E			5:25	5:29	5:30	OUT →
	5:34					
F		5:44	5:40		5:45	OUT →
G	5:54		5:55		6:00	OUT →
		6:04		6:06		
H	6:12		6:10		6:15	OUT →
I		6:27	6:25		6:30	OUT →
	6:52					
XXX	TIMED TRANSFER					

FIVE MINUTE LAYOVERS

COMPLETE CYCLE; i.e., DISTRICT 4 TO SPRINGFIELD TO KING ST. TO OXON HILL & BACK TO DISTRICT 4 REQUIRES 130 MIN.; WITH LAYOVERS.

FIVE MINUTE LAYOVERS
A, B, C, D, E, F, G, H, & I ARE THE NINE BUSSES RUNNING THE ROUTE.

JWL
10/19/92

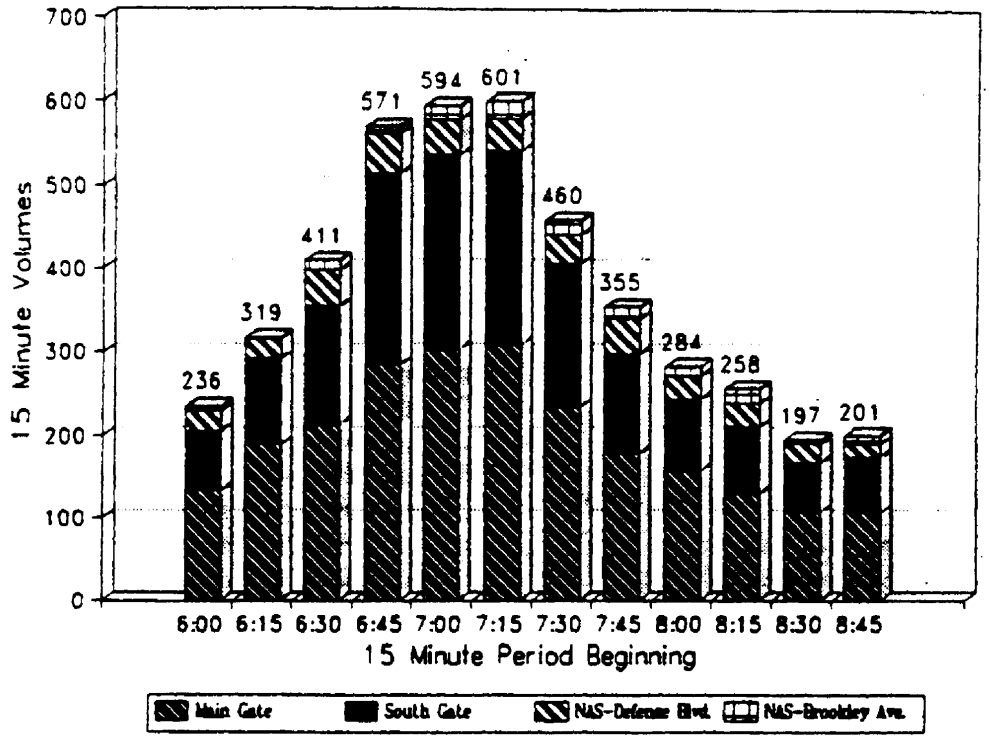
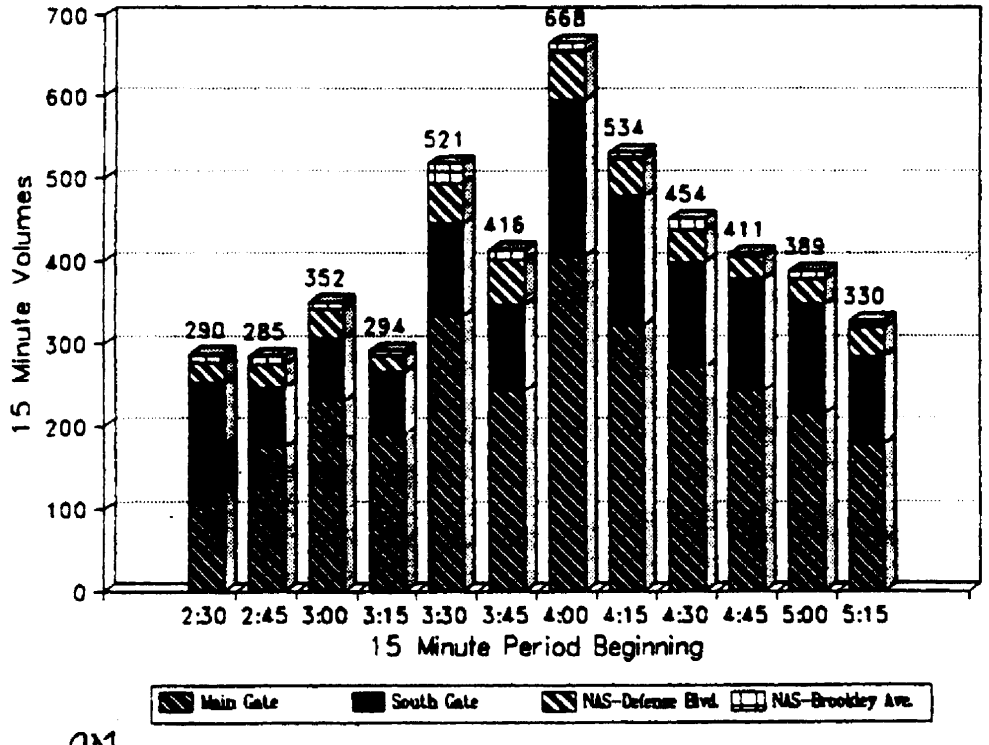


Figure I.4: AM Peak Period Inbound Traffic Volume Distribution



PM

Figure I.5: ~~AM~~ Peak Period Outbound Traffic Volume Distribution

TABLE 7
SUMMARY OF ROUTE PROJECTIONS

Route (mile/hrs)	Daily One-Way Ridership WB	EB	Annual Revenue ($1,000)	Annual Costs ($1,000) WMATA	Loc/Prv	Rev/Cost % WMATA	L/P	WB - Avg. Passengers per Trip AM	PM	EB - Avg. Passengers per Trip AM	PM
Route A-C (140,250/8,250)	247	162	$102	$508	$370	20%	28%	31	27	16	12
Route A-D (211,000/11,000)	247	400	$162	$715	$521	23%	31%	27	25	36	31
Route B-D (229,250/13,000)	332	400	$183	$814	$610	22%	30%	37	37	33	31

- Daily one-way ridership was obtained by taking the travel patterns of commuters from three data sources and estimating bus ridership on the westbound and eastbound bus routes using mode split estimates from COG's "Fact Book". Commuters are expected to ride the return bus in the evening. It should be noted that these ridership estimates are goals to be achieved after one year of operation.

- Annual revenue was based on $0.50 per trip times 250 operating days per year.

- Annual operating costs were derived from unit costs obtained from WMATA and a local/private operator (the Fairfax County Connector). Costs accounted for mileage, operating hours, and depreciation.

  It should be noted that these costs did not include any costs to acquire busses or other equipment should it be necessary to do so at start-up.

- Revenue to cost ratio, commonly called the cost recovery ratio, is a measure used in the transit industry to gauge the success of a particular service. A ratio of 35% is deemed acceptable for transit bus service. As indicated in the table, it is projected that Route A-D (if it was run by a local jurisdiction or private contractor) could have a cost recovery ratio of 31%, which is almost acceptable.

- Passengers per trip is another measure used by the transit industry. If, on average, 34 persons ride a bus, then that service is deemed to be acceptable. From this standpoint, Route B-D is the best of the three routes studied in detail.

VIII. POTENTIAL FUNDING

An exploration was made into potential funding sources for such a pilot bus program. Federal, State, and local sources were reviewed for their general applicability. While several of the programs offered some promise, no immediately available funds were identified for this purpose. A more detailed investigation was not pursued in Phase I, given the consensus of the Study Team regarding the viability of a pilot project, as discussed below.

IX. RECOMMENDATIONS

After completing the analysis and discussing the findings, it was the view of the Beltway Transit Study Team that Bus Route A-D exhibited the most potential of the routes studied in detail. However, the Team felt that they could not recommend to the Legislature implementation of this route as a pilot, stand-alone project at this time.

This conclusion was based on the Team's consensus that a primary objective of the Legislature's request for a pilot project was to relieve congestion on the Wilson Bridge. With 172,000 vehicles per day crossing the Wilson Bridge - approximately 8% (13,200) in the peak hour - a reduction in auto demand of 200 vehicles $\pm$ would have minimal impact on relieving congestion on the Bridge.

As a second phase to this Study, the Team recommends focusing on an intermodal systems approach to addressing congestion relief on the Capital Beltway - and the Woodrow Wilson Bridge in particular. Transit, van pools, car pools, subscription bus service, HOV lanes, timed transfer centers, and provision of park-and-ride lots around the Beltway Corridor all need to be examined to identify the potential for a "package" or "packages" of measures that could contribute substantially to congestion relief. Appropriate phasing and funding for implementation should be identified as part of this second phase process. To accomplish this, VDOT and the Department of Rail and Public Transportation will work with the Transportation Planning Board staff, local jurisdictions and Maryland through the regional process to develop a transportation program in the Beltway Corridor.

In the interim, the Study Team recommends an intensive marketing campaign to promote existing transit, carpool, and vanpool programs that have the potential for diverting single occupant vehicles from the Wilson Bridge. This effort should involve the area's ridesharing programs, working in concert to target larger employers and some residential neighborhoods in the Study area for transit and ridesharing promotions. Accompanying this effort there should be an overall examination of the adequacy of signage within the Beltway Corridor to direct commuters to existing transit facilities and services.